

Claims

- [c1] 1. A method of manufacturing a headliner for a vehicle, said method comprising the steps of:
- providing vacuum forming equipment including upper and lower mold halves;
 - providing thermoplastic material including at least one top and at least one independent bottom layer;
 - placing said top and bottom layers into the vacuum forming equipment adjacent forming surfaces of the upper and lower mold halves;
 - substantially sealing at least one of the upper and lower mold halves from atmosphere;
 - joining said top and bottom layers together to form an integral headliner; and
 - applying vacuum to at least one of said top and bottom layers at predetermined locations so as to form at least one cavity between said top and bottom layers.
- [c2] 2. The method according to claim 1, wherein said steps of providing vacuum forming equipment, providing thermoplastic material, placing, sealing, joining and applying are carried out to thereby provide a head impact compliant headliner for motor vehicles without attachment of

additional components on said headliner.

- [c3] 3. The method according to claim 1, wherein said step of applying provides surface contours on said top layer defining convex and concave members for absorption of impact energy.
- [c4] 4. The method according to claim 1, wherein said step of applying provides surface contours on said bottom layer defining convex and concave members for absorption of impact energy.
- [c5] 5. The method according to claim 1, further comprising the step of:
injecting other components between said top and bottom layers for increasing structural or function vehicle performance.
- [c6] 6. The method according to claim 3, wherein at least one of said convex and concave members being in shape of at least one hexagon, circle, triangle and square solid.
- [c7] 7. The method according to claim 4, wherein at least one of said convex and concave members being in shape of at least one hexagon, circle, triangle and square solid.
- [c8] 8. The method according to claim 3, wherein at least one of said convex and concave members being in shape of

at least one waffle, cone, conical section, pyramid, truncated pyramid, rectangular solid, rectangle, cube, sphere, spheroid, ellipse, truncated ellipse, rhombohedral solid, and truncated rhombohedral solid.

[c9] 9. The method according to claim 4, wherein at least one of said convex and concave members being in shape of at least one waffle, cone, conical section, pyramid, truncated pyramid, rectangular solid, rectangle, cube, sphere, spheroid, ellipse, truncated ellipse, rhombohedral solid, and truncated rhombohedral solid.

[c10] 10. The method according to claim 1, wherein said headliner is made of thermoplastic.

[c11] 11. A headliner for a vehicle made by the method of claim 1, said top and bottom layers including a plurality of surface contours, and said top and bottom layers substantially joined together and including at least one area therebetween defining said at least one cavity.

[c12] 12. A headliner for a vehicle, said headliner comprising:
at least one top layer including a plurality of surface contours;
at least one bottom layer including a plurality of surface contours; and
said top and bottom layers being substantially joined to-

gether to form an integral headliner including at least one area between inner surfaces of said top and bottom layers defining a cavity,
wherein said top layer is independent from said bottom layer prior to being joined to said bottom layer.

[c13] 13. The headliner according to claim 12, wherein said headliner is head impact compliant for motor vehicles without attachment of additional components on said headliner.

[c14] 14. The headliner according to claim 12, wherein said surface contours of said top layer define convex and concave members for absorption of impact energy.

[c15] 15. The headliner according to claim 12, wherein said surface contours of said bottom layer define convex and concave members for absorption of impact energy.

[c16] 16. The headliner according to claim 12, further comprising:
other components injected between said top and bottom layers for increasing structural or function vehicle performance.

[c17] 17. The headliner according to claim 14, wherein at least one of said convex and concave members being in shape of at least one hexagon, circle, triangle and square solid.

- [c18] 18. The headliner according to claim 15, wherein at least one of said convex and concave members being in shape of at least one hexagon, circle, triangle and square solid.
- [c19] 19. The headliner according to claim 14, wherein at least one of said convex and concave members being in shape of at least one waffle, cone, conical section, pyramid, truncated pyramid, rectangular solid, rectangle, cube, sphere, spheroid, ellipse, truncated ellipse, rhombohedral solid, and truncated rhombohedral solid.
- [c20] 20. The headliner according to claim 15, wherein at least one of said convex and concave members being in shape of at least one waffle, cone, conical section, pyramid, truncated pyramid, rectangular solid, rectangle, cube, sphere, spheroid, ellipse, truncated ellipse, rhombohedral solid, and truncated rhombohedral solid.
- [c21] 21. The headliner according to claim 12, wherein said headliner is made of thermoplastic.